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Barcelona Supercomputing Center
Centro Nacional de Supercomputación

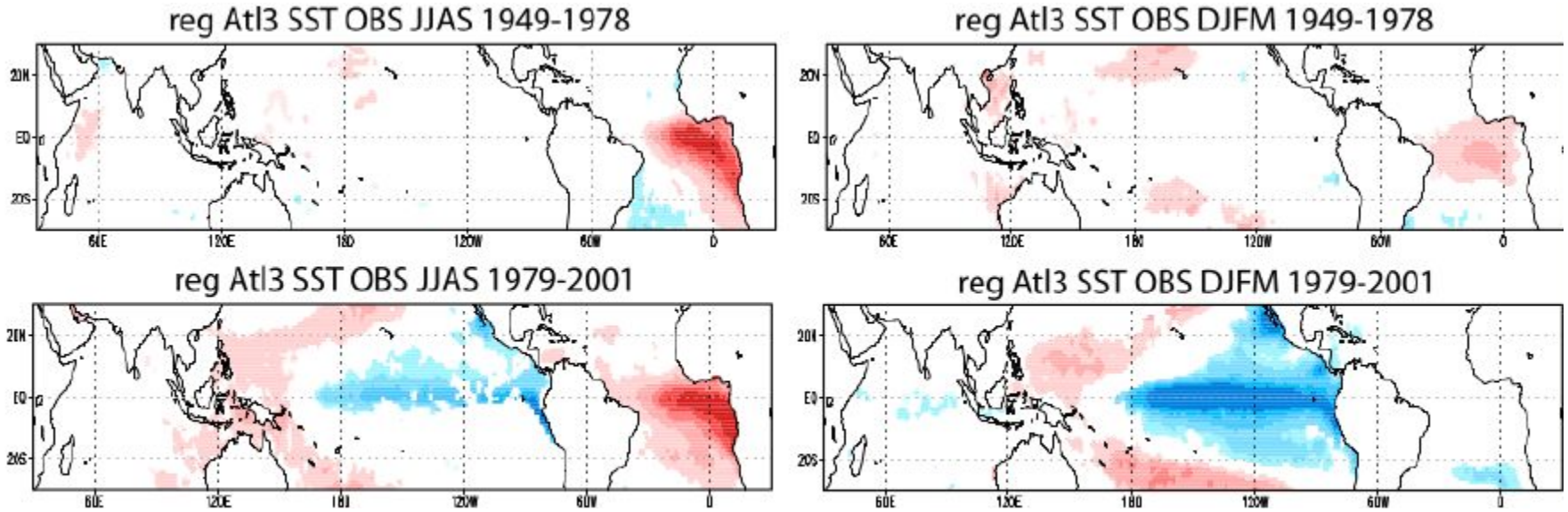
Impact of Tropical Atlantic variability on Tropical Pacific predictability

Eleftheria Exarchou

Maria-Belen Rodríguez De Fonseca (UCM), Teresa Losada (UCM), Irene Polo (UCM), Pablo Ortega (BSC), Yohan Ruprich-Robert (BSC)

TA variability influences ENSO variability

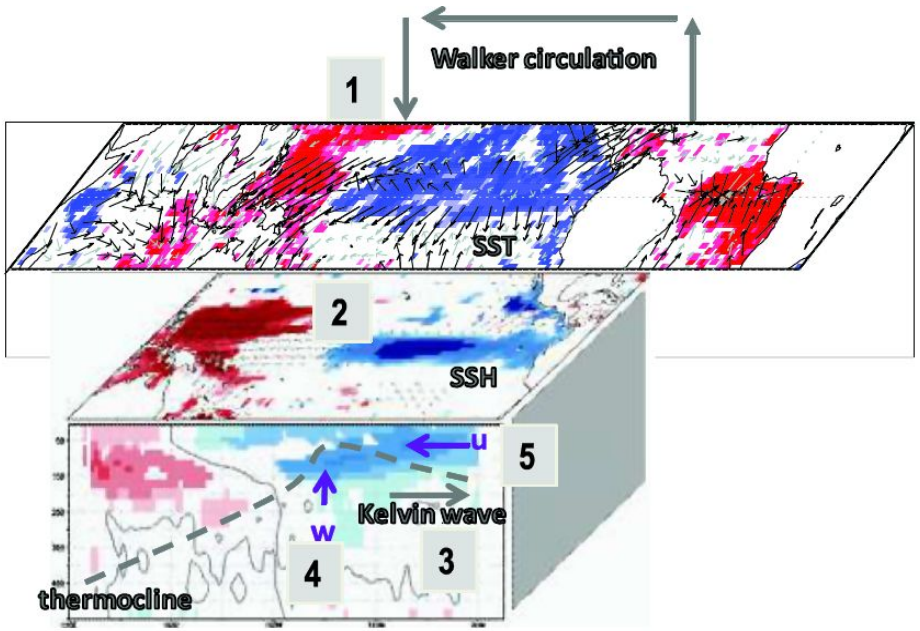
Summer equatorial Atlantic SST are highly anticorrelated with the winter SST in Tropical Pacific under a negative AMO



Rodriguez-Fonseca et al [2009]

TA variability influences ENSO frequency and variability

Summer equatorial Atlantic SST are highly anticorrelated with the winter SST in Tropical Pacific



From Polo et al., 2015

1. Anomalous heating from Atlantic Nino → anomalous convergence in Atlantic → anomalous divergence and subsidence in central/western Pacific

2. Anomalous easterly wind stress in central Pacific → anomalous Ekman upwelling and thermocline shallowing in Central Pacific → piling of surface warm water in the west Pacific

3. The thermocline anomaly propagates eastwards as a Kelvin wave

4. The shallowing thermocline brings cold water to the surface → stronger easterly surface wind anomalies (+ve feedback)

Impacts on ENSO predictability

Research questions:

- Are the models able to reproduce the ATL/PAC teleconnection?
- Does this teleconnection - if present- increase predictability of Tropical Pacific?

Methodology

Analysis of the North american Multi-Model Ensemble [NMME, Kirtman et al. 2014] and EUROSIP forecasts systems

- 14 systems in total
- February and June start dates, 8-10 months long, all ensembles available

Sensitivity study with EC-Earth

Seasonal predictions where we replace the wind stress over the Equatorial Atlantic

→ 5 members, 1980-2009, 8 months long , June initialization

- Does this increase the skill in the TA?
- Does the representation of the connection between the two basins improve?
- Does this increase predictability in the Tropical Pacific?

Impacts on ENSO predictability

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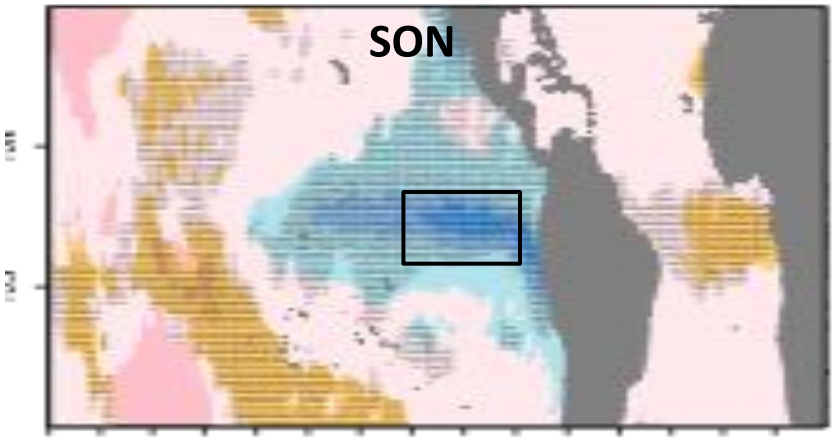
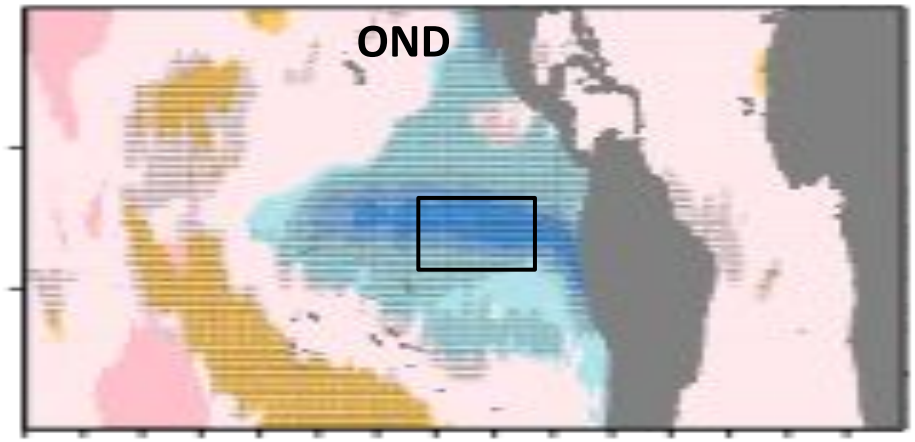
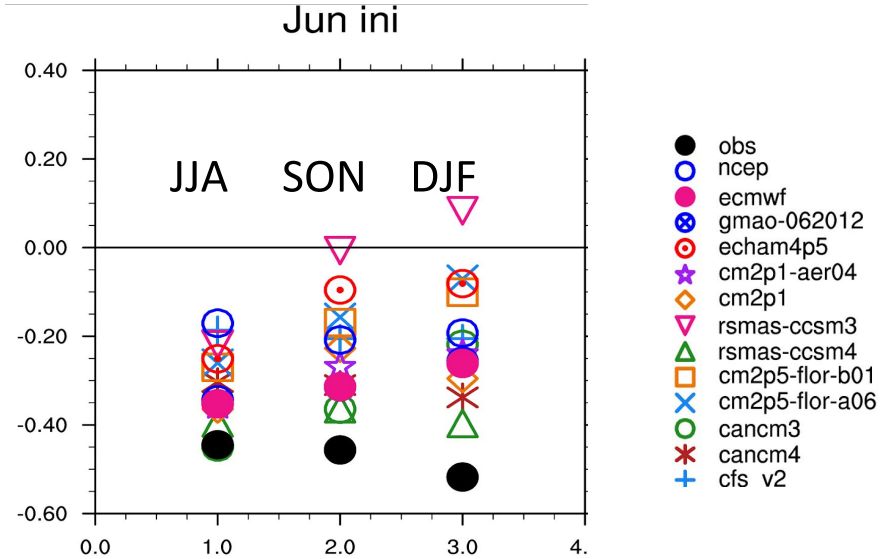




HadISST [Rayner et al., 2003]



Most June initialized forecasts are able to reproduce the teleconnection

Impacts on ENSO predictability

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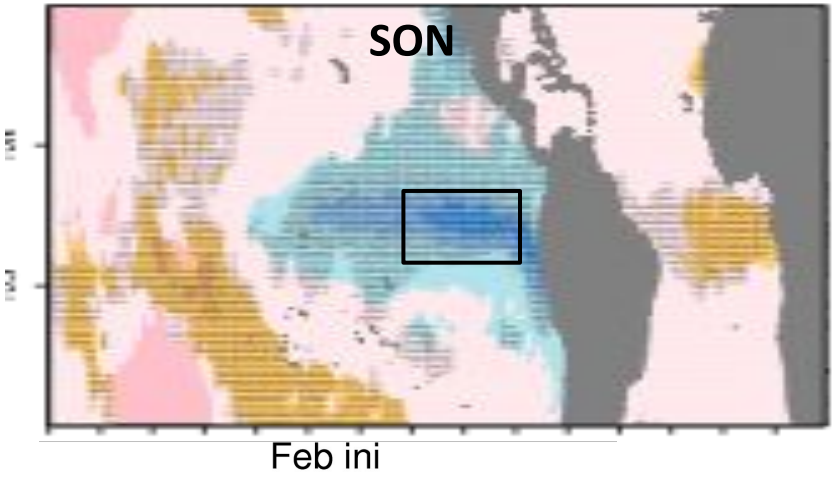
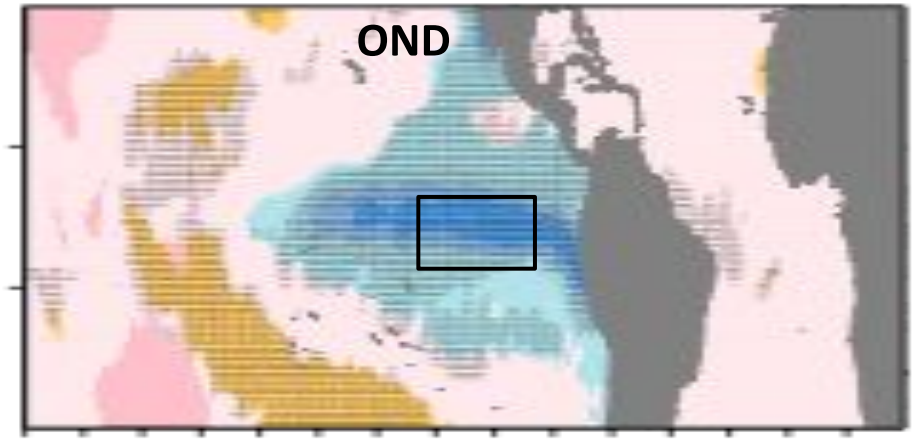
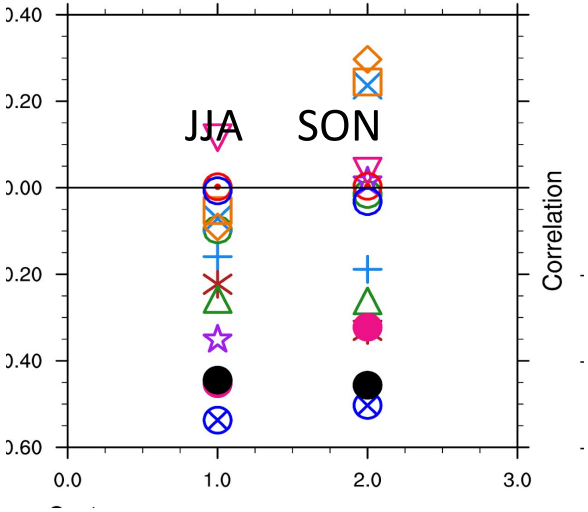




HadISST [Rayner et al., 2003]



obs
ncep
ecmwf
gmao-062012
echam4p5
cm2p1-aer04
cm2p1
rsmas-ccsm3
rsmas-ccsm4
cm2p5-flor-b01
cm2p5-flor-a06
cancm3
cancm4
cfs v2

Most June initialized forecasts are able to reproduce the teleconnection

BUT a lot of February initialzed forecasts are not reproducing the connection

Impacts on ENSO predictability

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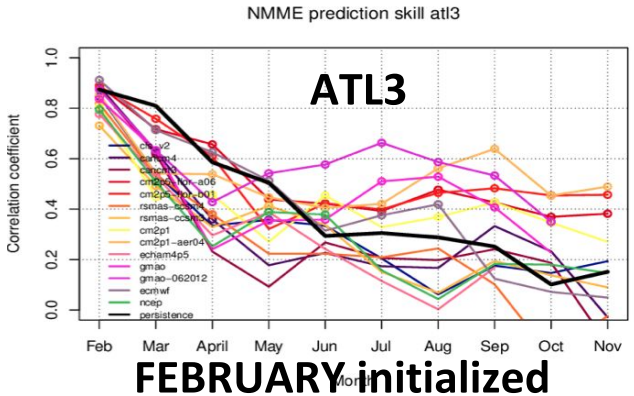
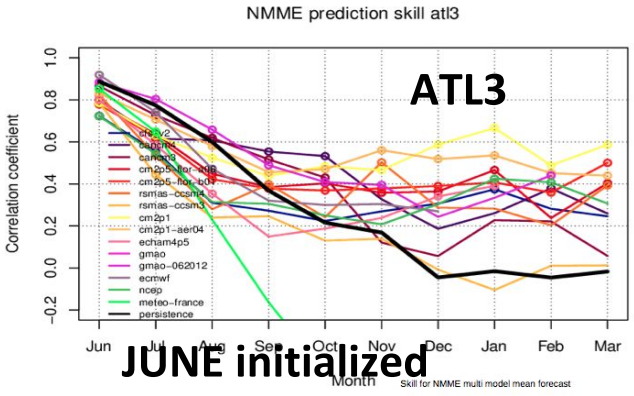
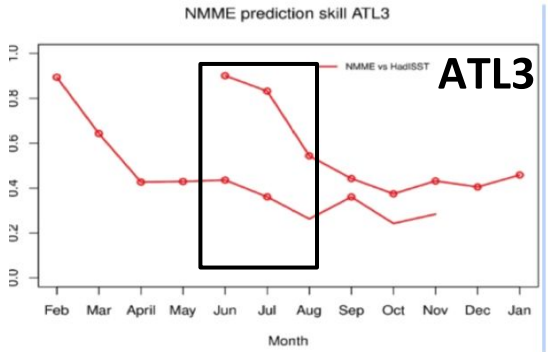
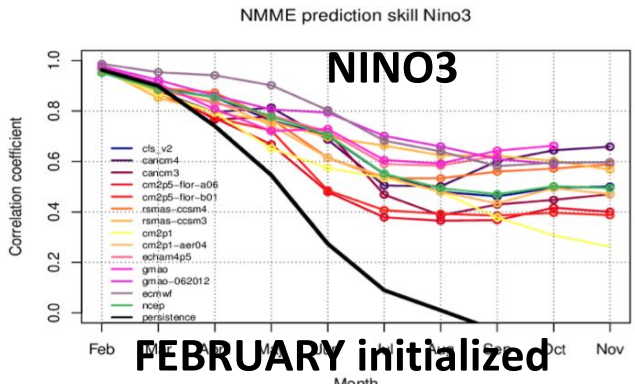


FEBRUARY initialized

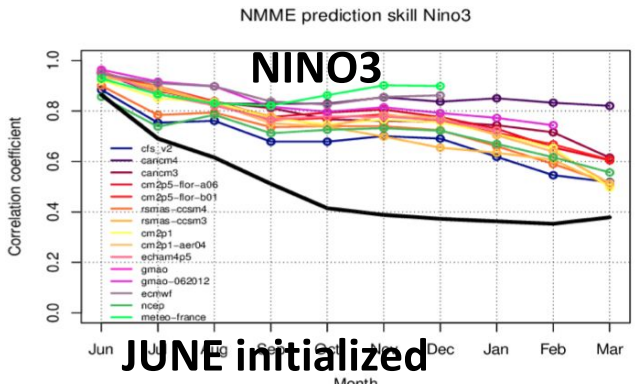


JUNE initialized

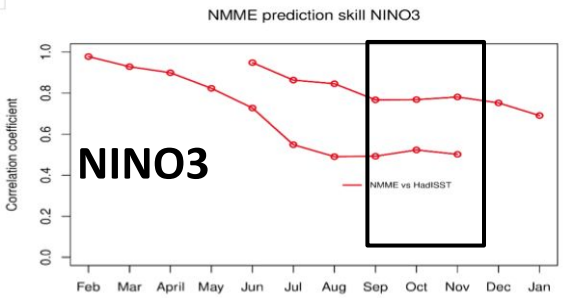




FEBRUARY initialized



JUNE initialized



June initialized forecasts have consistently higher skill in predicting ENSO than the February initialized at longer lead times, indicating a source of ENSO predictability in the initialization of June.

Impacts on ENSO predictability

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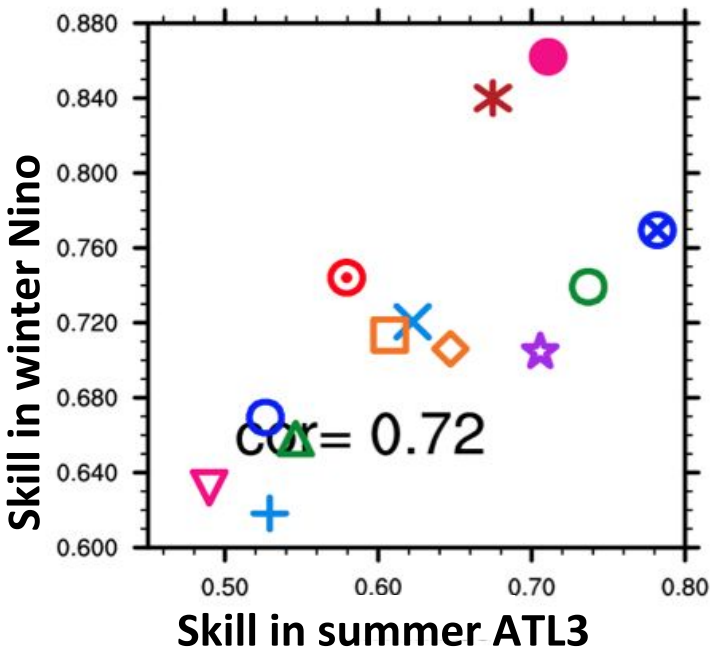
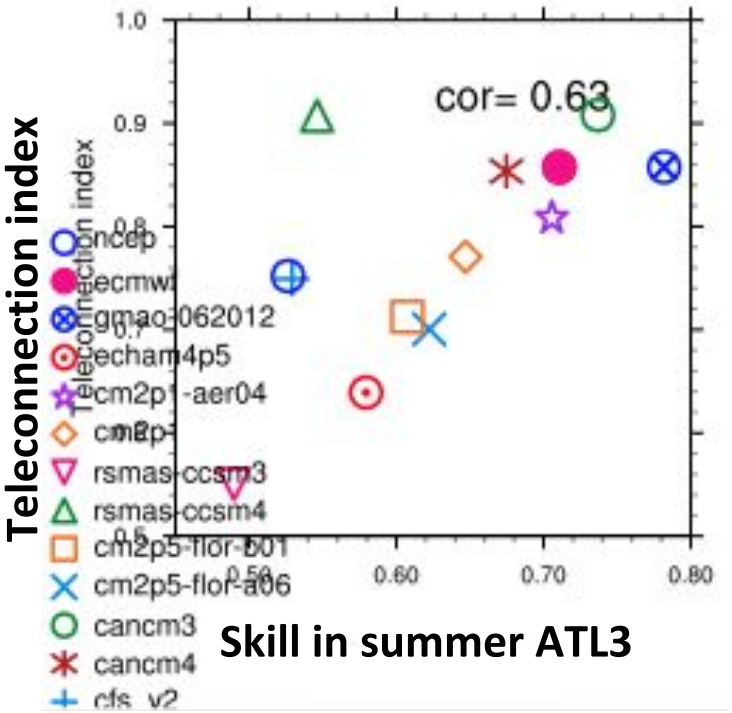




Models with high prediction skill over the summer Tropical Atlantic:

- **better reproduce the connection between the summer Tropical Atlantic SST and the winter Tropical Pacific SST,**
- **also have higher skill in predicting the winter Tropical Pacific SST.**

Case study: wind stress replaced over Equatorial Atlantic

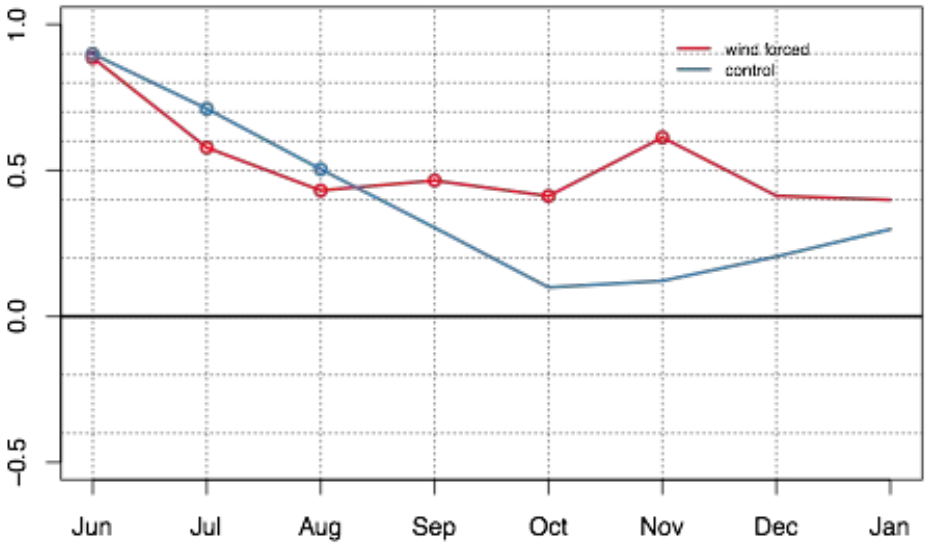
Model is EC-Earthv3.1

Wind stress is replaced in 3S-3N in Tropical Atlantic

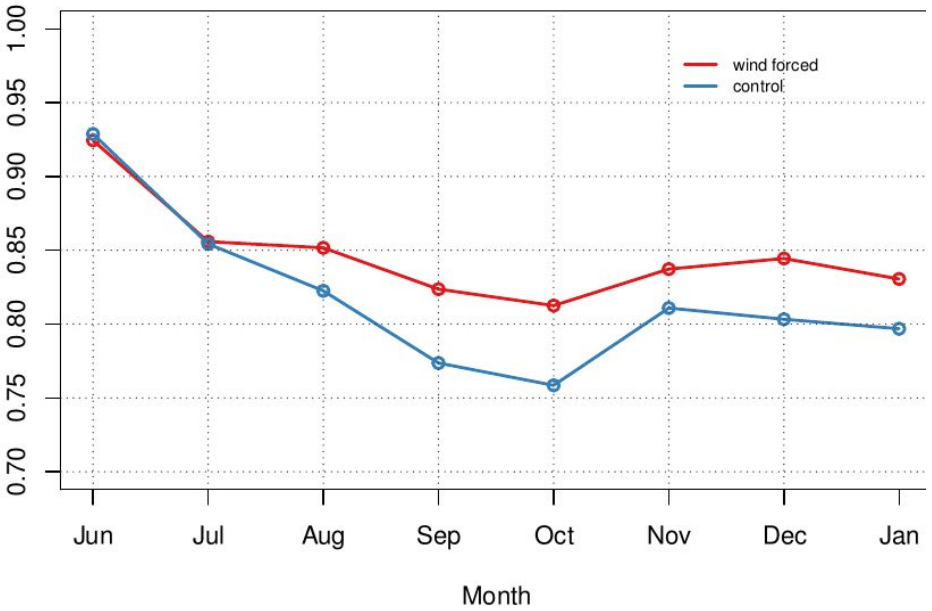
Seasonal prediction experiment with 5 members, June start dates, 8 months , 1980-2009

Case study: wind stress replaced over Equatorial Atlantic

Skill in ATL3



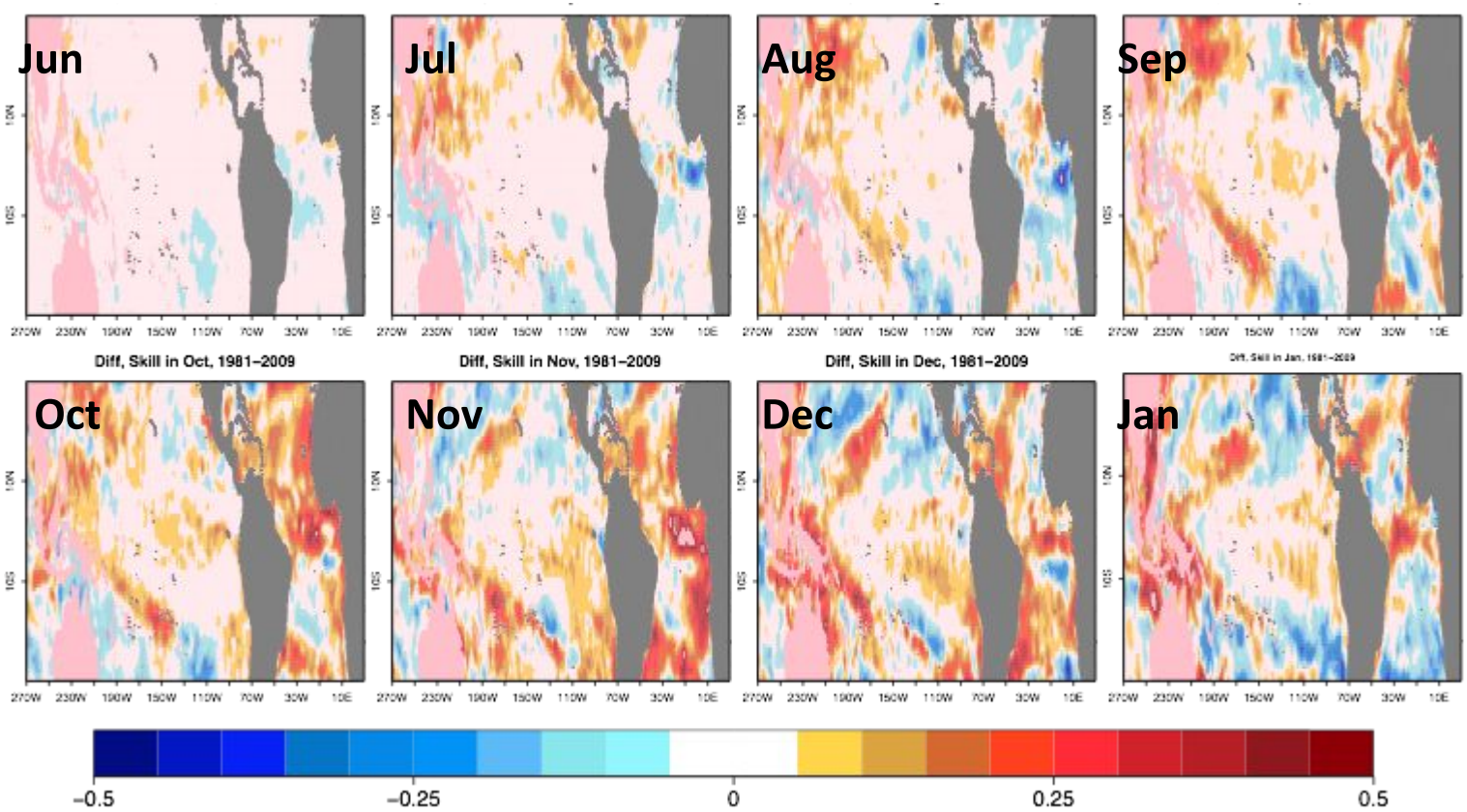
Skill in Niño3



- **Improvement of skill in Tropical Atlantc after 3rd lead month**
- **Improvement of skill in Nino3 after 2nd lead month**

Case study: wind stress replaced over Equatorial Atlantic

ACC of wind forced minus ACC in CTR



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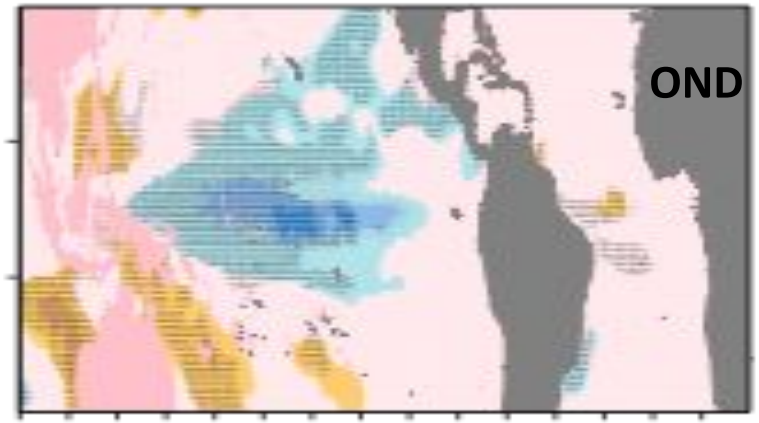
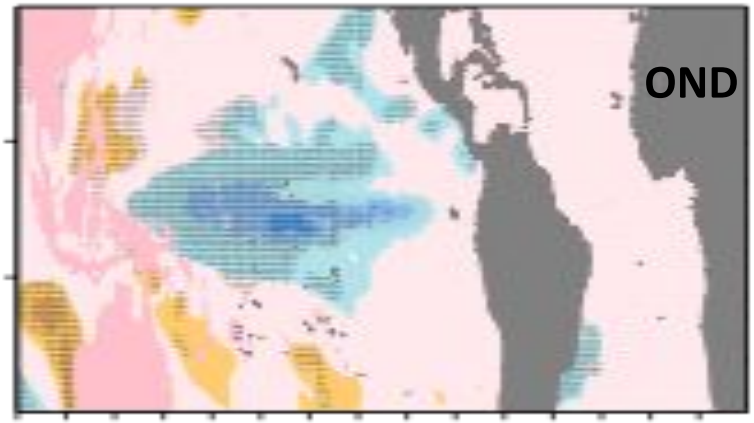
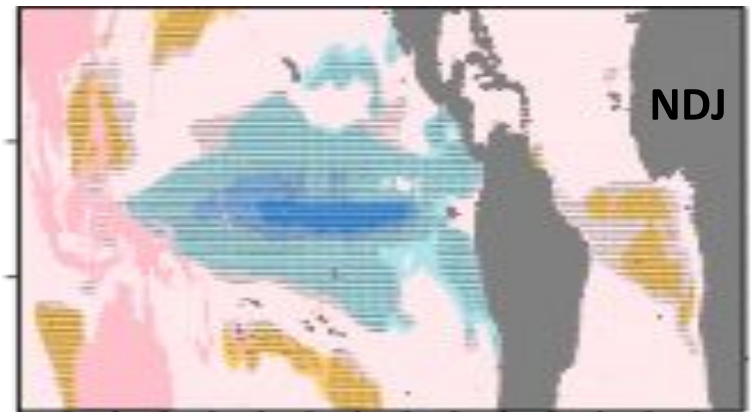
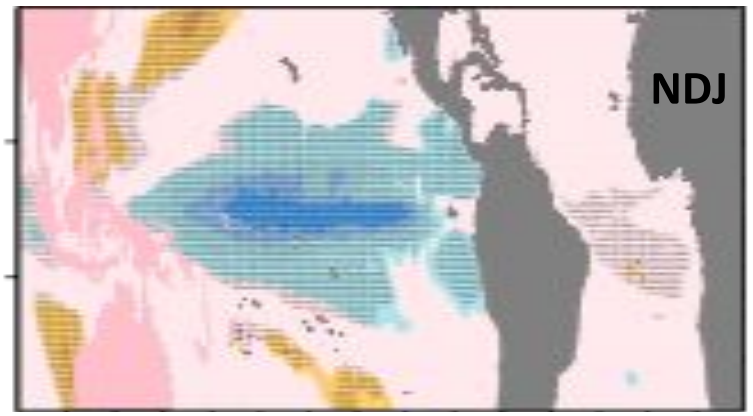




CTR

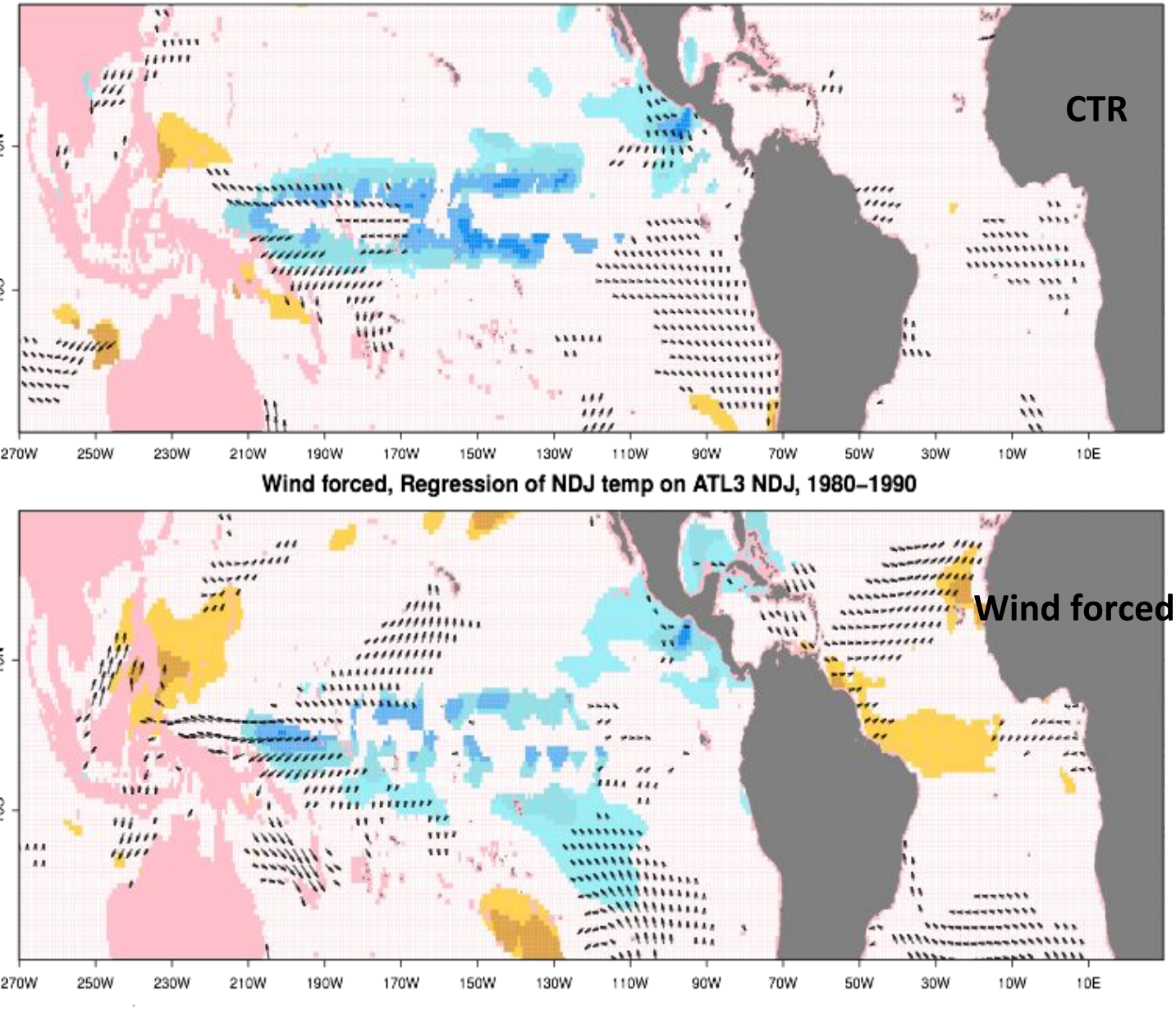




Wind forced

Sensitivity experiment reproduces better the teleconnection

Regression of winter SST and winds on summer ATL3



Limitation :

This is prelimiary plot:
The period shown is only 1980-1990 , need to extend this to 1980-2014

Summary

Models within the NMME/EUROSIP multimodel ensemble with high prediction skill over the summer Tropical Atlantic tend to

- **better reproduce the connection between the summer Tropical Atlantic SST and the winter Tropical Pacific SST**
- **have higher skill in predicting the winter Tropical Pacific SST**

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Replacing wind stress over Tropical Atlantic in EC-Earth v3.1 results in better teleconnection and higher skill in winter Tropical Pacific SST, BUT

Skill degrades in JJA in ATL3, before increasing in September onwards:

is this noise? → Extend 5 to 10 members and forecast to 2014 (done but not analyzed yet)
Might be that September onwards ATL variabilty impacts winter Pacific SST ?

Might be that other components improve (wind, convergence etc)? → to be further investigated

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THANK YOU FOR YOUR ATTENTION!

Skill in uas/vas in ATL3